Mercury Risk to Great Dismal Swamp Birds?

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Atmospheric Input & Mercury Methylation in Wetlands

Concern about Mercury Emerges

National Wildlife Refuge

Established 1974

111,000 acres of wetlands

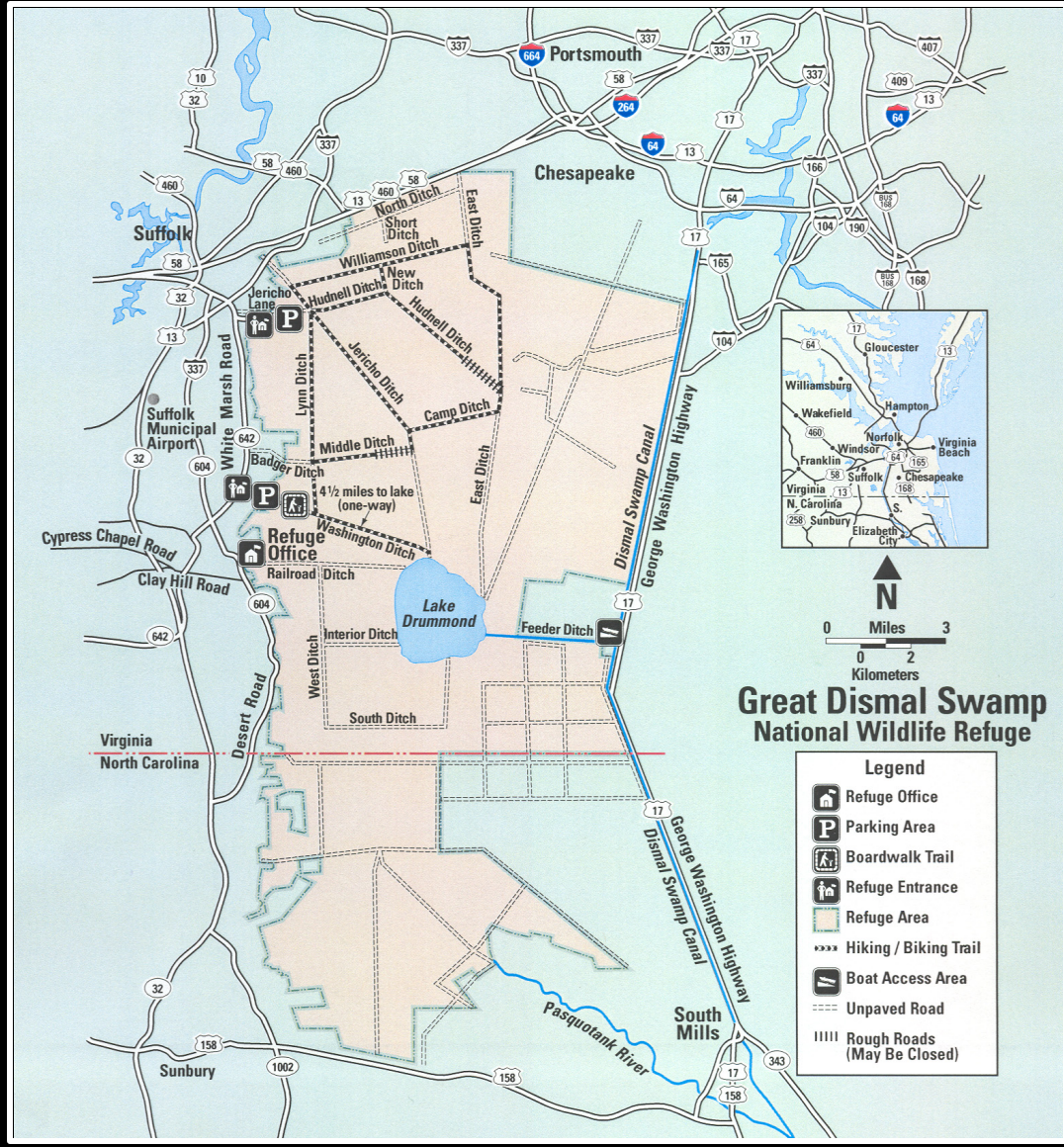
Lake Drummond

(largest VA lake)

Valued Habitat

In 2003, high mercury in chain pickerel & bowfin led Virginia Department of Health to issue consumption advisories.

Ecological risk?



Ecological Risk Estimation

Species

Bald eagle, Belted kingfisher, and Great blue heron

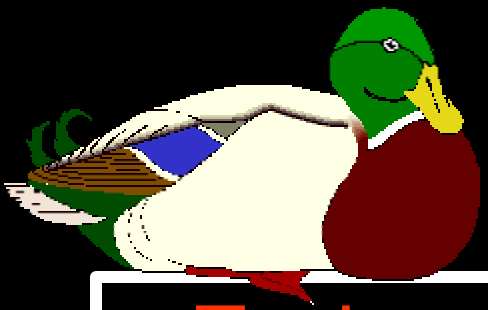
Measure of Risk

Probability of ingesting a harmful amount of mercury

Need to Know

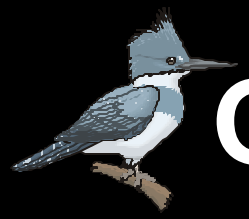
- Amount of ingested mercury above which harm might occur
- How much mercury a bird eats (ug Hg/kg of bird each day)
    - What prey a bird eats
    - Mercury concentrations in each prey species
    - How much prey a bird ingests daily
    - Size of a bird
- Consider the variation in how much the birds eat

Mercury Ingestion Threshold?



- Toxicant Reference Value (TRV)
  - Heinz (1979. *J. Wildl. Manage*. 43:394)
    - Mallard ducks exposed for several generations to 0.5 ug methylmercury/g of feed.
    - Significant reproductive effects
  - Recent communications (Evers, per. com.)
    - 0.5 to 0.8 ug/g might be appropriate
  - Translates to ug/kg body mass per day

    65 to 100 ug mercury/kg-day



Gathering Risk Information

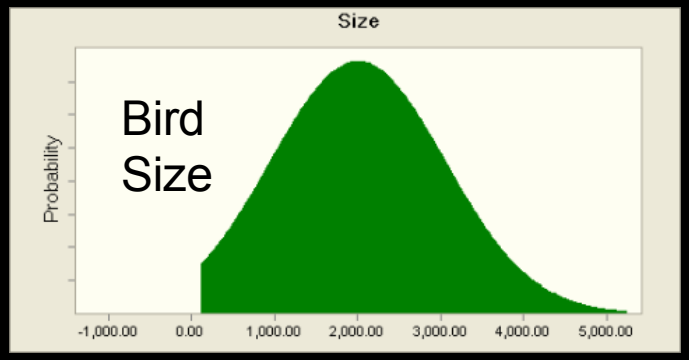
Characterizing the Birds Relative to Feeding

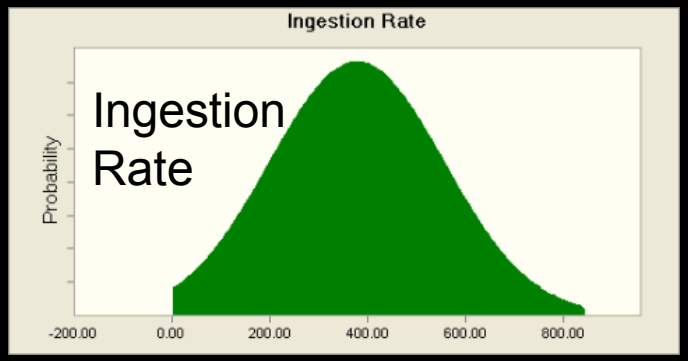
- Measured mercury in prey fish and amphibian species
- Measured weights of prey items
- Literature and FWS interviews to determine what each species eats
- Literature search for bird qualities
    - Weight
    - How much a bird eats daily

$$\text{Intake}(\text{ug/kg} - \text{day}) = \frac{\sum_{i=PW1}^{IR} C_i W_i}{BW}$$

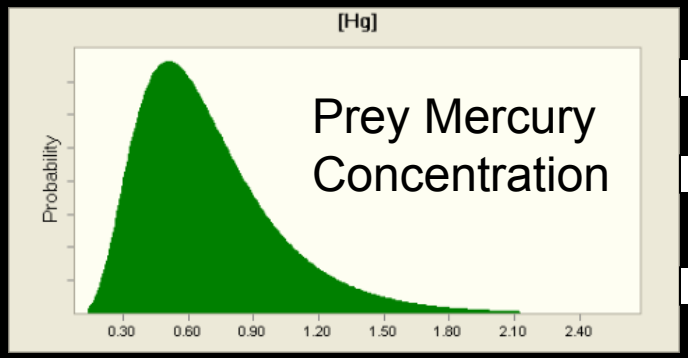
Generating Risk Information

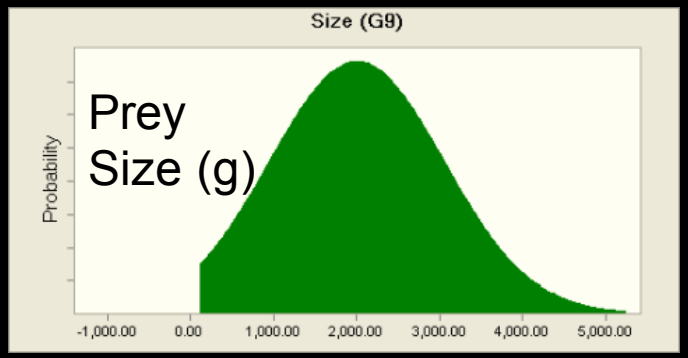
Accounting for Variation (Monte Carlo Technique)



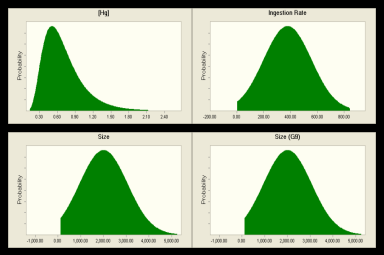


$$Intake(ug/kg-day) = \frac{\sum_{i=PW1}^{IR} C_i W_i}{BW}$$





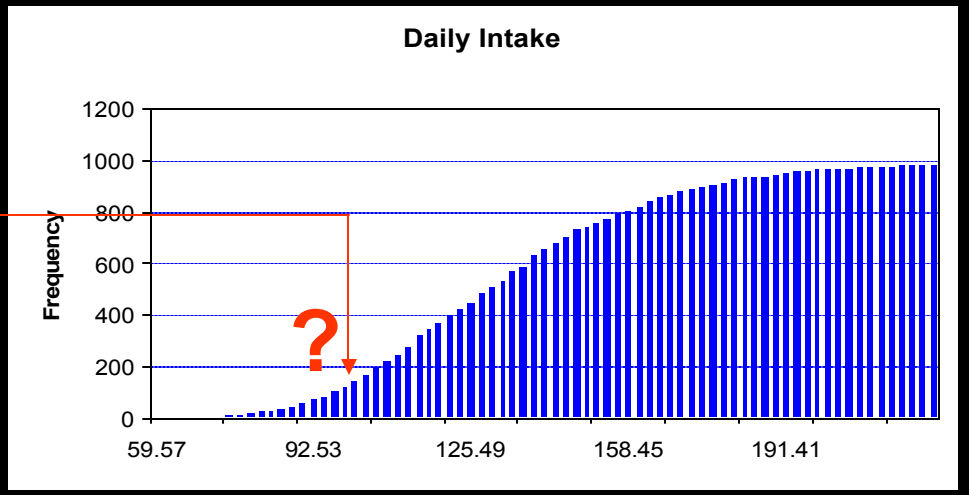
Monte Carlo Output



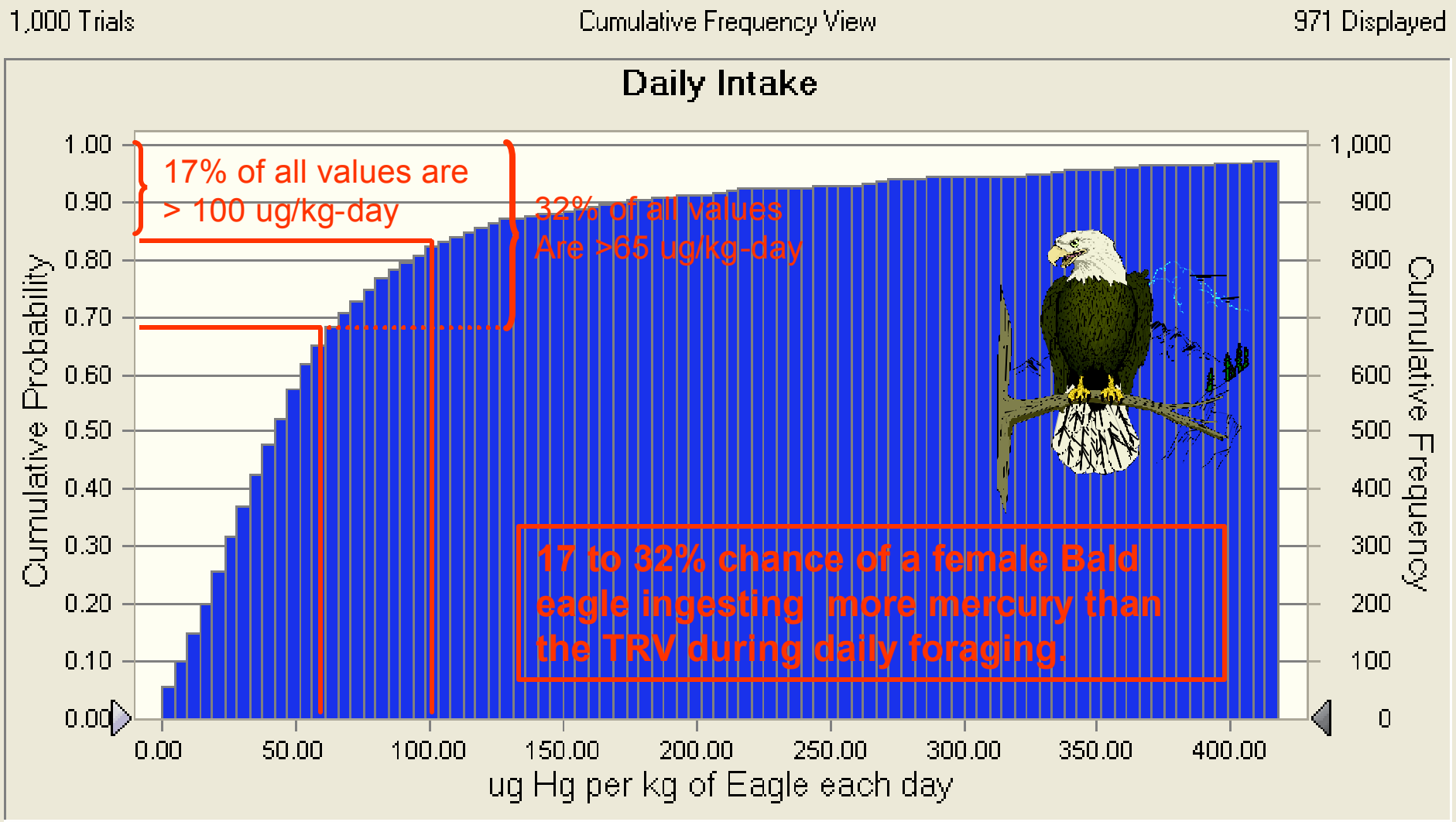
$$Intake(ug/kg-day) = \frac{\sum_{i=PW1}^{IR} C_i W_i}{BW}$$

Random
Trials (1000)

TRV



Results – Bald Eagle



Results

17 to 32% chance of a female Bald eagle ingesting more mercury than the TRV during daily foraging.

78 to >98% chance of a female kingfisher ingesting more mercury than the TRV during daily foraging.

<<1% chance of a female heron ingesting more mercury than the TRV during daily foraging.

Significance

Atmospheric deposition coupled with conditions favorable to mercury methylation do create conditions for high exposure.

Human consumption advisory set in 2003. This study showed risk to two species.